

Maintaining Visibility of the P5 Report

HEPAP
December 2015

S. Ritz

Building for Discovery

Strategic Plan for U.S. Particle Physics in the Global Context



Report of the Particle Physics Project Prioritization Panel (P5)

May 2014



A Fine Start!

- **Thanks to the efforts of many:**
 - **Community letter organized by DPF and Users Organizations, >2000 signatures gathered in 1st week**
 - **an important message given our earlier reputation as a “fractious” community**
 - **A sustained sequence of rollout activities:**
 - **interactions with decision makers and outreach to other fields**

During the late summer of 2013, the DOE and NSF charged the High Energy Physics Advisory Panel (HEPAP) to constitute a new Particle Physics Project Prioritization Panel (P5) with a goal of developing a 10-year strategic plan for U.S. particle physics in the context of a 20-year global vision. P5 recently completed its work and its report was unanimously endorsed by HEPAP on May 22, 2014. As scientists, engineers, and students from 144 U.S. universities and laboratories, we write to express our strong support for the P5 Report.¹ This plan describes a world-leading program of discovery and we urge that it be incorporated into the plans of the DOE and the NSF.

The report proposes a compelling and balanced strategy of exploration and discovery. The funding profile is realistic. By following it, we will maintain our historic position as a global leader and reliable international partner in this exciting science. The plan invests in the strengths of the US Particle Physics Community, optimizing our resources to address the five critical and intertwined science drivers identified by P5: to exploit the Higgs boson as a new tool for discovery; to pursue the physics associated with neutrino mass; to identify the physics of dark matter; to understand cosmic acceleration, dark energy and inflation; and to explore the unknown, new particles, new interactions, and the principles that govern them.

The P5 report relies on the work of an extensive community study (“Snowmass”) commissioned by the Division of Particles and Fields of the American Physical Society, our professional society of particle physics. Over the course of a year a thousand members of our community, organized in dozens of far-flung working groups, considered the scientific opportunities in depth covering all areas of our field. This work culminated in a 10-day meeting in August 2013 where the comprehensive documentation for P5’s deliberations was completed. Then over the subsequent nine months, P5 held multiple face-to-face and virtual community meetings, and maintained an active website for community input. The resulting P5 report distilled the accumulated wealth of scientific opportunities into those that best serve the science drivers, while also making hard choices among many outstanding scientific programs. Support among our community has solidified behind this exciting report as witnessed by our attached **2095 signatures gathered in seven days**: we stand behind the P5 plan.

Now that our community has reached consensus, we look to you for the necessary support to execute this plan that will enable us to maintain and enhance our position as global leaders in this exciting program of discovery science and technological innovation.

Sincerely,
The U.S. Particle Physics Community

cc: Dr. France A. Córdova, Director, National Science Foundation
Dr. Patricia Dehmer, Director, U.S. Department of Energy Office of Science
Dr. Denise Caldwell, Director, Physics Division, National Science Foundation

¹ <http://usparticlephysics.org/p5/>



Maintaining Visibility

- There is a growing sense that now is a good time to do more. Some needs:
 - **An improved brief brochure with clear messages**
 - **Messages where/when needed:**
 - Maintain effectiveness and coherence, with project proponents and the agencies, in the context of the full P5 report.
 - Support and build upon the hard work that our colleagues are already doing, visiting decision makers with clear and effective messages when needed.
 - Continue to make the case for particle physics.



Brochure

- Brief (2 pages, based on P5 report and earlier brochures):
 - The wonder and excitement of particle physics
 - The field has a clear direction and plan: an affordable program of great impact in the international context. A track record of success.
 - Building for discovery: clear and inspiring questions can be addressed with tools we know how to build now. The importance of sustained R&D.
- **An insert (2 sides) frequently updated:** 
 - Recent advances
 - Asked DPF for inputs (experiment and theory). DPF also contacting sibling divisions of APS (DPB, DAP, DNP)
 - It has been a very productive year programmatically as well!
 - What's important to accomplish in the coming year
 - In close consultation with the agencies
- Circulate widely in the community for comments and suggestions (DPF et al., HEPAP, agencies, community meetings, users groups, labs, projects, target audiences,...). Also seeking advice from other fields that already do this well.
- Discussed this approach at August DPF meeting



Two-page Insert ****DRAFT****

Brochure Insert Contents Draft

v4

Particle physics is a dynamic and global field that is successfully executing its program according to plan. Major **recent advances** include:

- The Large Hadron Collider (LHC) experiments have measured the Higgs boson mass to 0.19% precision, a fundamental parameter whose value and existence were uncertain just a few years ago. This, along with the first measurements of other essential Higgs boson properties, demonstrates the scientific power of the LHC, which has now further expanded its discovery potential with the recent start of its higher-energy (13 TeV) operations.
- The NOvA experiment, with less than 10% of its ultimate data set, has already produced intriguing hints about the arrangement of neutrino masses, a longstanding key question in neutrino science.
- The Dark Energy Survey discovered 17 dwarf galaxy candidates, providing valuable new venues to search for clues about the fundamental nature of dark matter.
- Evidence was found for exotic *pentaquark* states, configurations of matter that had been postulated but never observed, by the LHCb experiment at CERN.

It has been a very productive year programmatically as well:

- The historic U.S.-CERN agreement was signed on May 7, 2015, ensuring smooth continuation of this remarkably productive and mutually beneficial collaboration. Now, for the first time, CERN is investing in facilities outside Europe, including at Fermilab.
- The neutrino program made major advances:
 - Planning for the long-baseline neutrino facility (LBNF) and Deep Underground Neutrino Experiment (DUNE) has become truly international, providing a worldwide focus of scientific research and ushering in a new era at Fermilab. This new alignment happened faster than expected, signaling the great interest in this unique opportunity. Design efforts to produce the world's most powerful neutrino beam at Fermilab and plans to construct the detector facility in South Dakota are proceeding well.
 - A coordinated set of short-baseline neutrino experiments is being developed to address anomalous results in previous experiments, while advancing the R&D necessary for LBNF and DUNE. The startup of the MicroBooNE experiment at Fermilab this year was an important step in this direction.
- Unique and complementary next-generation direct detection dark matter experiments were selected to move forward towards construction: LZ, SuperCDMS, and ADMX-Gen2.
- The Large Synoptic Survey Telescope (LSST), led by the NSF Division of Astronomical Sciences with a massive 3.2 gigapixel camera provided by DOE and international

partners, was given final approvals for start of construction. The Dark Energy Spectroscopic Instrument (DESI) has received DOE approval for its project cost, schedule, performance, and scope and is now moving forward on final design and fabrication activities.

- The accelerator R&D program priorities for the coming decade were spelled out in detail in a new HEPAP subpanel report, following the overall strategic plan of the P5 report.

This Year (2016)

The P5 Report provides a clear strategy and set of priorities for U.S. investments by NSF and DOE over the coming decade. In that context, the **top 4 Priorities in the coming year are:**

- Maintain the recommended investment balance among scientific research, facility operations, and the selected portfolio of small- medium- and large-scale projects that facilitate the successful implementation of the community's strategic vision.
- Execute current construction projects that will enable the next big discoveries in particle physics, including the ATLAS and CMS upgrades, DESI, Mu2e, Muon g-2, LSST, LZ, ADMX, and SuperCDMS.
- Identify critical R&D investments in transformational technology that would significantly improve the performance, and reduce the cost, of future accelerators.
- Solidify international partnerships to establish the first U.S.-hosted global science facility, LBNF.

In the meantime,

- All eyes are on the LHC, as it embarks on the highest-energy running. The U.S. is working with CERN and the LHC experiments to determine the appropriate scope and details of U.S. contributions to the future High-Luminosity LHC upgrades of the accelerator and detectors. This was the highest-priority near-term major project in the P5 report.
- Great new data are becoming available from currently operating experiments, including the Dark Energy Survey (DES), NOvA, current-generation direct and indirect dark matter experiments, and many more.
- Japan is considering hosting the International Linear Collider (ILC), which would provide exciting and important discovery potential beyond the LHC.
- The vibrant U.S. particle theory community is poised to interpret upcoming results from the LHC, as well as preparing for results from the next generation of neutrino experiments and experiments in dark matter, dark energy, and cosmology. Researchers also pursue the deepest and most vexing questions about the foundations of theoretical particle physics.

With these carefully chosen investments, there will be a steady stream of exciting new results for each of the five Science Drivers and enabling technologies over the coming decade.



Accomplishments (1)

- Particle physics is a dynamic and global field that is successfully executing its program according to plan. Major recent advances include:
 - The Large Hadron Collider (LHC) experiments have measured the Higgs boson mass to 0.19% precision, a fundamental parameter whose value and existence were uncertain just a few years ago. This, along with the first measurements of other essential Higgs boson properties, demonstrates the scientific power of the LHC, which has now further expanded its discovery potential with the recent start of its higher-energy (13 TeV) operations.
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 - Evidence was found for exotic pentaquark states, configurations of matter that had been postulated but never observed, by the LHCb experiment at CERN.



Accomplishments (2)

- It has been a very productive year programmatically as well:
 - The historic U.S.-CERN agreement was signed on May 7, 2015, ensuring smooth continuation of this remarkably productive and mutually beneficial collaboration. Now, for the first time, CERN is investing in facilities outside Europe, including at Fermilab.



Accomplishments (3)

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Discussion
